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ABSTRACT

The purpose of this study was to determine the relationships between academic achievement, rote learning, learning for understanding, cognitive style, and the medium of presentation (print versus television) for adult students in lifelong learning situations. A content learning package was prepared for presentation in the two media and administered to 181 subjects. Following this instruction, the subjects were tested for achievement and rote/understanding levels of learning. Analysis of the results indicated that subjects receiving the print treatment scored significantly higher on the rote level questions than they did on the understanding level questions. Subjects receiving the television treatment scored significantly higher on the understanding level questions than on the rote level. A significant relationship between cognitive style and achievement occurred. It also was found that field-independent subjects scored higher than field-dependent subjects on rote questions. (RL)

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LEARNERS COGNITIVE STYLE AND LEVELS OF LEARNING IN TELEVISION AND PRINT INSTRUCTION FOR USE IN OPEN LEARNING: AN EXPLORATORY STUDY*

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LEARNERS COGNITIVE STYLE AND LEVELS OF LEARNING IN TELEVISION AND PRINT INSTRUCTION FOR USE IN OPEN LEARNING: AN EXPLORATORY STUDY

The rapid growth of people involved in lifelong learning has been of specific interest to educators for quite sometime. As a concept, lifelong learning has been described by Goul[illegible]nd Cross (1972) as prompting the development of educational [illegible]ograms designed to provide learning packages which use a variety of media for the adult learner. The current terms of "open learning," "teaching at a distance," "non-traditional study," and "lifelong learning," include programs with a wide variety of instructional goals and are used here interchangeably. The purpose of the present study is to examine the effects of learning packages, student cognitive style and achievement within the open learning environment. Open learning instruction is used to mean learning experiences that are free from traditional time and space limitations that are fully controlled by an instructor or institution.

The role of learning packages and media of all types appears to be increasing in use within open learning instruction. Yet, little is known about the learning characteristics of students choosing open learning instruction. Little is known, for example, about the cognitive style of these students and how current methods of instruction (i.e., books, television, audio tapes, film, or radio) affects their learning.

Historically, media research has not concentrated on the open learning student but rather how one medium relates to another method of instruction (e.g., television compared to lecture, discussion, or programmed). The

two questions asked by researchers have been traditionally (1) do media teach, and (2) does one medium (i.e., television) teach more effectively than another (i.e., radio)? The answer to both questions has generally been yes. (Schramm, 1977; Salomon, 1974). Numerous research studies provide further evidence to support the use of media in learning. But Salomon (1974) points out:

> ...we are left with the open question of what media characteristic facilitate instruction on what kinds of tasks and for what types of learners. (p. 384)

Thus, Salomon is suggesting that while researchers have demonstrated that media can teach, and students can learn from media, some methods of instruction are at times better than others.

In general, studies in television and print material have concentrated on the manipulation of the medium itself in order to make comparisons. To date, investigations comparing different media have not been concerned with levels of learning and how they affect student achievement. The early research comparing effectiveness of various kinds of media was concerned mainly with identifying learners as sixth graders or college sophomores, rather than comparing learner differences with achievement.

Researchers in media and learning theory are now calling for research that addresses individual differences in learners. (Schramm, 1977; Messick, 1976; Berliner and Gage, 1976). While several approaches have been advanced attempting to establish a systematic body of research on individual differences, no single theory on how learners process information has found widespread acceptance. (Snow, 1976; Gagne and Briggs, 1974; and Hill, 1971).

Three basic conclusions can be drawn from the literature: (1) research

on instructional media has centered fruitlessly on various comparisons of media and teacher lectures rather than on "what" media can teach, (2) researchers in individual differences recognize the value of media instruction and have called for relationship studies between media and individual differences, specifically the investigation of the relationship of cognitive style to learning through media, and (3) levels of learning appear to be a potentially powerful means for investigating what can best be taught through media.

RATIONALE FOR HYPOTHESES

Research on cognitive learning styles has been conducted for over twenty-five years. But, it is only recently that increased interest in individual differences has brought cognitive style research into increased prominence. (Witkin, Moore, Goodenough, & Cox, 1977). Research studies have centered on three areas: (1) methods of teaching, (2) learner achievement, and (3) what effect cognitive style has on vocational preference. The lack of apparent paralleling among these three areas points toward the need for a comprehensive body of research in this area.

Two studies have provided a general background for the present investigation into cognitive style. Robinson and Gray (1974) investigated the relationship between cognitive style and school learning in children. The results indicate that a relationship exists between a particular style and certain school learning variables which may be an important consideration in assigning children to different instructional treatments. The implication is that certain learner styles function best with certain methods of instruction. The second study by Coop and Brown (1970) reaches a somewhat different con-

clusion. They compared the effects of cognitive style and method of teaching on two categories of learning achievement and found that while teacher structured lecture was superior to self-study, there was no relationship between method of teaching and cognitive style or between cognitive style and achievement. Even though these studies reached slightly different conclusions, they address the basic question of looking at the use of cognitive styles as a means of investigating both the teaching process and the effects of individual differences on learner achievement.

Involvement between cognitive style and media can be traced at least as far back as 1968 when Briggs in his six-year review of studies on educational media and technology, identified the area of cognitive style. (Briggs, 1968). His review only identified one study that used cognitive style measurements as a means to evaluate media effectiveness. (Snow, Tiffin & Seibert, 1965). But Briggs did recognize the potential of this type of investigation. He states:

> ...that if one were to design media to adapt media programs rigorously to the individual learner's general ability, special aptitudes, and entering competencies, most of the variance would be accounted for, as compared to such variance as may reflect those characteristics meant by cognitive style. (p. 172)

In the same year as the Briggs review, Snow and Salomon (1968) published a paper on the nature and relevance of aptitudes to instructional research with particular reference to film and television. In their article, Snow and Salomon called for investigations that would identify existing relationships between learner aptitudes and media instruction. In response to this call

for research, Snow (1970) reported how media research and aptitudes could be used for improving instruction. His study, however, contained only two actual research citations demonstrating the lack of extensive investigation in the area. Salomon, like Snow, also saw the need for research into the effects of individual differences on what is learned from different types of media. He said;

> Research on media needs to be closely related to research in other areas such as human development, individual differences, information processing, etc., and to become part of them. (1970, p. 33)

Despite these stated needs for media and cognitive style relationship studies, there has been little productive research. The remainder of this section reviews specific studies that apply cognitive style research in reference to media.

Maginn (1975) compared tape recorded instruction at various rates and difficulty. He found that field independent subjects scored better than field dependent subjects, regardless of which audio treatment they received. This points in the direction of establishing that audio messages work better with field dependents. However, this was the only study found that dealt directly with the issue. It is not possible to generalize on the basis of this limited evidence.

Taft (1978) compared media to live lecture actually using a slide tape presentation for the media portion of his investigation. The results were not significant but subjects rated the slide tape as more effective. Snow, Tiffin & Seibert (1965), in another study, used short films and live lecture to compare retention between written and television instruction. While no

significant difference was found, the data approached significance in the direction of field independent subjects scoring better with a live presentation and field dependent subjects scoring better on the film presentation.

A study by Zaner (1977) asked subjects to perform certain procedural tasks. The results indicated that while field independent subjects performed the tasks faster, the field dependent subjects performed the total procedure more correctly.

Peterson and Magaro (1969) conducted a study employing only a reading treatment and compared cognitive style and other individual differences in good and poor readers. They hypothesized that cognitive style would be significantly related to reading achievement when intelligence was excluded. The hypotheses were not statistically confirmed, but the results were in the predicted direction. The results do suggest that field dependent subjects tend to be poor readers when compared to field independent readers.

The studies reviewed up to this point have been concerned with the relationship of cognitive style in live to live presentations, audio to audio presentations, a video to video presentation, a video only and a print only.

In her dissertation, Koran (1969) used the Hidden Figures Test and written or television treatments to determine if the cognitive style aptitude had positive value in measuring achievement with different media. Koran concluded that the written treatment worked best for those subjects scoring high on the Hidden Figures Test (field independent) and video treatment was best for the subjects receiving a low score (field dependent). Koran's study applies directly to the present investigation as both studies are addressing differences in retention that can be attributed to the relationship between cognitive style and

media.

Koran, Snow and McDonald (1971) used teachers to determine if acquiring teaching skills by written or video modeling was related to cognitive style. Analysis of variance showed that video modeling produced significantly higher performance than did written modeling and that field independent teachers scored better from written modeling than did field dependents. The reverse was also significant, field dependent teachers scored higher on the video modeling treatment. The results are similar to those found by Koran. These two studies appear to show a relationship between retention, cognitive style, and media.

The results of available studies indicating a relationship between cognitive style and media are shown in Figure 1. The number in each cell indicates combined results of studies discussed above and points toward an overall tendency to identify field independent learners as scoring higher from instruction in either audio or written form. Field dependent learners consistently scored higher from video presentations. Although the consistency of results from previous studies has much merit, the total number of studies is small and not all the studies reported findings that were significant. (Snow, Tiffin & Seibert, 1965; Peterson & Magaro, 1969). Previous studies have sometimes focused their attention within a single medium, (Peterson & Magaro, 1969; Maginn, 1975; Zaner, 1977), or on a comparison with live lecture. (Snow, Tiffin, & Seibert, 1965). Only two studies were found that compared media of interest to the present study. (Koran, 1969; Snow, Koran & McDonald, 1971).

FIGURE 1

	Television	Audio	Print
Field Dependent	4		
Field Independent		1	3

A review of cognitive style research that utilized media reveals that very few studies have been conducted. While it is apparent that some interest exists in establishing relations between cognitive style and media, current research is minimal. The conclusion is that more research is needed showing the relationships between cognitive style and media.

While many claims have been made regarding the effectiveness of media, only a few studies have been directly related to levels of learning or cognitive style. Only one media-oriented study addressed the open learning student and it relates only slightly to cognitive styles and not at all to levels of learning. (Brown, Brown & Danielson, 1975). Several print studies found some support for higher levels of learning as well as lower order learning. (Richards & Di Vesta, 1974; Watts & Anderson, 1971). However, several theorists such as Gagne (1974), Allen (1970), and Cavert (1974) have called for and predicted various other relationships between media and levels of learning. Nevertheless, the predicted relationships between media and levels of learning have not been clearly established.

While one group of researchers and theorists study the relationships between media and levels of learning, another group has focused their attention on possible relationships between the learner's cognitive style and the method of presenting the material. General findings indicate that field dependencs learn better from film (Taft, 1978) while field independents learn more from

reading. (Peterson & Magaro, 1969). The two most significant findings relating cognitive style to media (Koran, 1969; Koran, Snow, and McDonald, 1971) agreed that field independents learn better from written messages and field dependents learn better from television. While the consistency of these results are encouraging, all of the existing studies were conducted with either children or college students rather than open learning students.

Very little is known about the learning traits and needs of learners who elect open learning instruction. There does not appear to be any evidence on the effect cognitive style has on students' ability to learn material at different levels of complexity. And finally, there is no evidence concerning the cognitive style of open learners, level of learning, and medium of presentation.

The little research that has been done on open learning students, their learning traits and their needs, plus the insufficient and conflicting research evidence on the relationship between media, levels of learning, and cognitive style have generated the following hypotheses:

H_1 There will be no significant interaction effects between media and cognitive style at the rote and understanding levels of learning.

H_2 There will be a difference between the media on learner achievement at the rote and understanding levels of learning.

H_3 There will be a difference between learner cognitive style and achievement at the rote and understanding levels of learning.

METHOD

Subjects

Subjects were selected from an initial total population of 600 adult students. These subjects reside in and around the city of _____, _____,

and adjacent _____ County in _____. The subjects were randomly selected from adults with previous experience in open learning instruction. Open learning instruction is defined as instruction based on self-contained instructional packages without the direct aid of a teacher. No attempt was made to select subjects on any basis other than previous open learning experience. Each subject received a five dollar honorarium for participating in the study.

Independent Variables

The two independent variables in this study were: (1) modes of presentation--television, and print, and (2) cognitive styles--field dependent-mobile-field independent.

A review of instructional materials described by the producers of open learning instruction indicates that the two primary methods of communicating open learning instruction are print and television. As a result, these two mediums were used.

The second independent variable was the learner's cognitive style. The identification of the subject's cognitive style was by the score received on the Group Embedded Figures Test. This test classifies subjects along a 0-18 continuum. Scores are divided into three groups that identify characteristics common to that group of subjects. Field dependent, mobile, and field independent are the terms used to identify the differences in cognitive style scores.

Dependent Variable

The dependent variable was achievement. The achievement test was developed by the researchers. A multiple choice test was designed to measure the two independent levels of learning: rote and understanding.[1]

Two procedures were used to determine the validity of the achievement test. The first determined the validity of the two levels of learning and the second determined the content validity of the instrument. In order to determine the validity of the levels of learning (rote and understanding) five experts with experience in college level learning theory were selected. Each expert was provided with a definition of the two kinds of learning and a pool of test questions. The judges were instructed to read the descriptions of the two kinds of learning and then to classify each question into one of three categories: (1) rote, (2) understanding, or (3) neither rote nor understanding. The decision to retain an item was based on agreement of at least four of the five experts as to the question's classification. Items which are classified as neither rote nor understanding were dropped. The content validity of the achievement instrument was determined by a second group of five experts with experience in preparing instruction in the field of business. This group was asked to read a copy of the transcript of the stimulus message and then to make two judgements about the items. First, can the item be answered from the material presented in the stimulus message? Second, is one of the alternatives the correct answer? Agreement among all five judges was required.

In addition, a control group was used as a check on the validity of the achievement test. The means and standard deviations of the control group appear in Table 1. A significant difference was found between the control group (n=30) and the treatment groups (n=181) at the understanding level, F (2, 207) = 9.37, $P < .0002$ and at the rote level F (2, 208) = 86.018, $P < .0001$. Therefore, the achievement test was considered valid.

TABLE 1

Control Group Means and Standard Deviations
for Rote and Understanding
n=30

Means		Standard Deviations	
Rote	Understanding	Rote	Understanding
3.20	4.43	1.54	1.88

The thirty items selected from the original pool were administered to the treatment groups. A total of 181 subjects took the achievement test. These results were then item analyzed. Ten items from the thirty were judged to be either ambiguous, too difficult, or too easy. These items were eliminated from the final analysis. The rote questions (n=10) retained for the final analysis ranged in difficulty from .36 to .98 and discrimination ranged from .20 to .50. The difficulty index of the understanding questions (n=10) ranged from .57 to .91 while the discrimination index ranged from .28 to .49.

The reliability estimates on the twenty questions (both rote and understanding combined) was .59. The Cronbach alpha for the understanding questions =.44. The rote question Cronbach alpha = .35.

The overall reliability estimate was considered adequate given the number of items (n=20) on the achievement test. The reliability estimates for both rote and understanding levels were also considered adequate. Based on the

overall estimate and given the item analysis (difficulty and discrimination indexes) the test was judged to have adequate reliabil

Stimulus Message

The stimulus message topic was: How to Start Your Own Business. The selection of this topic came as a result of a national survey of potential topics suggested by adult learners. (Ross, Brown & Hassel, 1973). The Ross study indicated a high preference for general information on the topic area of business and personal finance practices.

A general content package was developed on the topic in cooperation with the _____ field office of the Small Business Administration (S.B.A.). This content package was based on materials used by the S.B.A. in conducting their business seminars.

The content package was developed into the two communication modes of television and print. A level of learning design that categorizes the content material into the two classifications of rote and understanding was prepared by the researchers as described by Bloom (1956) and provided to the professional scriptwriter. The writer then prepared the media script. The script was visualized for television and produced into a thirty-minute program. The print message was a transcription of the TV version. The two versions were checked for internal consistency.

Data Analysis

Multivariate analysis of variance (MANOVA) was used to test the data. The use of MANOVA provides two levels of analysis and an a priori decision should be made as to which is going to be used. The two choices are: (1) a collective test for significance -- the global *F* or (2) the step down *F*.

Significance within the step down F is not always consistent with the global F, thus an a priori decision must be made for using one or the other. The step down F was chosen based on the following: the research reviewed shows that differences in achievement could be identified as differences in levels of learning. For example, Dwyer (1968) and Bundy (1960) found that rote learning could be identified and that achievement was greater when the material was presented by television. Watts and Anderson (1971) and Shavelson, et. al. (1974) found levels of learning could be separated out of a general achievement variable when using prose learning materials. Thus, given these results of previous studies, it seems appropriate that the step down F be used as the primary statistic.

When the direction of significance cannot be explained by observing the mean tables, post hoc Scheffs were used. The alpha level for all statistical test was set at the .05 level.

RESULTS

No significant interaction between media and cognitive style was observed. The step down F analysis for understanding questions was $F(2, 174) = .932$, $P > .05$. The analysis of the rote questions was $F(2, 175) = .759$, $P > .05$. The means and standard deviation for the interaction hypothesis for the understanding level appear in Table 2. Table 3 contains the means and standard deviation information for the rote level. Table 4 contains the actual cell sizes. Therefore, the interaction hypothesis was supported.

The main effect for media was found to be significant for both understanding and rote learning. The primary analysis for understanding level questions yielded $F(1, 175) = 4.06$, $P < .05$. Since the understanding level

reached significance, a re-order of variables to observe the independence of the rote level was performed. The results of the re-order yielded F (1, 174) = 4.08, $P < .05$. The direction of the media effects become clear when observing the mean score information in Table 5. The means clearly identify the print medium as being more effective for rote learning and the television medium as being more effective for understanding learning. Therefore, the hypothesis for media was supported.

TABLE 2

Mean Scores and Standard Deviations
for Understanding Questions
n=181

	n	Means	Standard Deviations
Television	92		
Field Dependent	36	7.25	1.96
Mobile	30	8.23	1.79
Field Independent	26	8.46	1.20
Print	89		
Field Dependent	33	7.39	1.51
Mobile	29	7.75	1.32
Field Independent	27	7.77	1.55

TABLE 3

Mean Scores and Standard Deviations
for Rote Questions
n=181

	n	Means	Standard Deviations
Television	92		
Field Dependent	36	6.47	1.69
Mobile	30	7.03	1.29
Field Independent	26	7.88	1.42
Print	89		
Field Dependent	33	6.90	1.56
Mobile	29	7.51	1.45
Field Independent	27	7.74	1.45

TABLE 4

	Print	Television	Control
Field Dependent	33	36	
Mobile	29	30	30
Field Independent	27	26	

TABLE 5

Combined Means for Media

	n	Rote	Understanding
Television	92	7.05	7.91
Print	89	7.36	7.62

The independence of the cognitive style variable was obtained by re-ordering the variables and placing the cognitive style variable ahead of the media variable. Different results were obtained for the two levels of the dependent variable. Cognitive style was not significant for the understanding level of achievement F (2, 174) = 1.26, $P > .05$. Cognitive style was significant for the rote level of achievement F (2, 175) = 8.45, $P < .05$. As a re-order of the levels of the dependent variable was not appropriate, additional multivariate analysis was not conducted. Thus, the rote level portion of the cognitive style hypothesis was supported.

A secondary analysis using post hoc Scheffe tests was conducted on rote learning by cognitive style. Comparisons were made among the possible combinations of the three categories of cognitive style. Results indicated that mobile subjects were not significantly different than either field dependents or field independents $P > .05$. Field dependents were found to be significantly different from field independents $P < .05$. As can be seen by the mean scores in Table 6, field independent subjects scored significantly higher than field dependent subjects on the rote level items. There was no significant differ-

ence on the understanding level questions.

TABLE 6

	n	Rote	Understanding
Field Dependent	69	6.68	7.31
Mobile	59	7.27	8.00
Field Independent	53	7.81	8.11

The predicted results of the study were upheld in part for each of three hypotheses. Media did not interact with cognitive style to affect achievement. Media subjects in the print group scored better with rote level material and subjects in the television group scored better with the understanding level material. The cognitive style of the subjects was significantly different with rote level questions. Field independent subjects scored better than did the field dependent subjects.

DISCUSSION

The use of open learning instruction is expanding rapidly in the United States. These "new students" represent a population of learners about which very little is known.

The first research hypothesis investigated by this study was: <u>There will be a difference between the media on learner achievement at the rote and understanding levels of learning</u>. This hypothesis was supported. Previous research relating to the present study covered a variety of media and individual issues but does not represent a comprehensive or conclusive statement.

Studies within the television medium have traditionally centered on the techniques of the medium (Chu & Schramm, 1967) rather than how learning occurs. Print studies have dealt with language and placement of words, sentences, and paragraphs in the message rather than on what happens with the learner. (Frase, 1967).

Previous research suggests television was more successful with rote learning while print instruction was more successful with understanding learning. The results of the present study do not appear to support these previous conclusions and places doubt on them. Results from the present study do correspond with the learning model developed by Cavert (1974). This model identifies rote learning skills with print medium and understanding learning skills with television.

On the basis of the present study's findings, it appears that one interpretation of the conflicting results of the past media comparisons studies may be explained by the level or levels of learning employed in the message and measured through the achievement test used in those studies. Success of the instructional media message may well reside in the level of learning built into the message and the appropriateness of the achievement instrument in detecting the presence of a given level of learning. If one level of learning operates more successfully with one medium than another, the appropriate combinations of level and media should be employed.

While the statistical significance of the media hypothesis has been supported, the practical significance of the difference between media treatments is small. The results showed an actual difference between media means of .31 for the rote learning and .29 for understanding learning. This is not interpreted as a power-

ful difference by the researchers. Even though the difference is small, the study did find a significant difference between the two media and achievement for two levels of learning.

The second research hypothesis investigated by this study was: There will be a difference between learner cognitive style and achievement at the rote and understanding levels of learning. This hypothesis was supported. Several studies have dealt with portions of this hypothesis but no single study has dealt with the specific question. While the effect of cognitive style on learning through media was identified by Briggs (1968), research to date has not been sufficient to arrive at any general conclusions. Attempts to relate cognitive style to achievement have met with mixed success. Two previous studies indicate that field independents consistently scored higher than field dependents. (Taft, 1978; Peterson & Magaro, 1969). The present study also found that field independents scored higher than field dependents. Although not part of the design of the present study, these results deserve further investigation. A study by Coop & Brown (1970) found no relation between cognitive style and achievement. This point was investigated in the present study and a significant difference was found. Coop and Brown used a general achievement test in reaching their findings which may account for their results. The use of a levels of learning designed test in the present study indicates support for statistical significance between achievement and cognitive styles.

The two cognitive style studies most closely related to the present investigation (Koran, 1969; Koran, Snow & McDonald, 1971) reached findings similar to the present study, i.e., print appears to work best with field independents

and television appears to work best with field dependents. However, several differences exist between these previous studies and the present investigation. First, the previous studies used a different population of learners than did the present investigation. Second, each of the previous studies employed a general achievement test. Neither of the two previous studies looked at the levels of learning in either the stimulus message or the achievement test. If the current study's findings are correct, only the rote level questions would have caused a significant difference between the treatment groups in the previous research.

On the basis of the findings in the present study, it appears that cognitive style is related to the levels of learning being tested. It would appear that researchers attempting to investigate the relationship between cognitive style and learning should consider the levels of learning as part of their investigation.

A significant relationship between cognitive style and achievement was established in the present study. The significance found was that field independents score higher than field dependents on rote questions.

LIMITATIONS OF THE STUDY

Although significance was obtained for the media hypothesis and a portion of the cognitive style hypothesis, a larger number of subjects would have resulted in a more comprehensive study. Second, the relatively few items used on the actual analysis may be related to the results. Had there been more items on the achievement test, it is likely that the item analysis data would have improved. Thus the achievement test may have provided more information about the role of the understanding level in learning.

IMPLICATIONS FOR DEVELOPERS OF OPEN LEARNING INSTRUCTION

Several conclusions can be drawn from the research conducted in the present study. First, we know very little about the learning characteristics of the open learning student. What little research does exist leads to the conclusion that these students represent a special learning population that is uniquely different from other learning populations.

Second, the present study clearly indicates that individual differences in learners affects their success in open learning instruction. Specifically, this study supports cognitive style as an individual characteristic that affects success. Learners of one cognitive style (field independent) score higher on one kind of learning question (rote) than do learners of another style (field dependent). While it is seldom possible to identify the cognitive style of open learning students, this study supplies some assistance in that more field independent students enroll in open learning instruction than is the case with on-campus instruction. This study also indicates that field independent students are more likely to be successful in open learning instruction than are field dependent students. Therefore, it seems that developers of open learning instruction should be aware of research on cognitive styles and create instructional packages to fit the style characteristics of open learners.

Third, since open learning instruction depends on media to carry the instruction; considerable attention should be placed on the instructional nature of the media. The present study supports the notion that one kind of instruction (rote) is best provided by one medium (print) and another kind of

instruction (understanding) is best provided by another medium (television). Thus, the careful assignment of instructional tasks (levels of learning) is an important consideration in developing open learning materials.

IMPLICATIONS FOR FURTHER RESEARCH

The findings of the present study indicate that both media and cognitive style influence achievement. However, the relatively small actual significance found in the study leads to the need for further investigation.

Probably the most evident need for future research is to replicate the present study. While the significant findings of this study contribute to both media and cognitive style research, they do not establish general principles of instruction and additional studies to confirm these results need to be conducted.

Additional investigations using media not employed in the present study should be conducted. This research might well include studies combining media in such a way as to appeal to more than one sensory perception, thus providing the learner with additional means of acquiring the information.

Cognitive style research is only beginning to influence the development of instructional materials. The present study added to the meager knowledge concerning the influence of cognitive style on learning; but additional studies need to be conducted particularly in relationship to levels of learning. Specifically, investigations comparing learner styles to different populations with different media.

The present study looked at two levels of learning (rote and understanding). Future investigations of learning at these and other levels of learning could serve to more precisely discriminate among learners and achievement. For ex-

ample, studies pertaining to levels of learning and other individual differences would further establish the validity of using levels of learning as a criteria for development of instruction.

Additional research is suggested that would relate the cognitive style of the devloper of the media and the achievement test to the cognitive style of the learner. For example, in the present study a person with a highly field independent style developed material on which field independent subjects scored best. The question becomes: what influence does the developer's style have on the style of the instruction? Thus, the need to investigate the relationship between the style of the developer and the style of the student should be conducted.

Research on the learning characteristics of open learning students needs to be encouraged. While a great deal of demographic data is available, there is little research on how learning occurs with the open learning population.

Finally, comparisons should be made between open learning students and other learner populations. One way to establish the characteristics of a group is to compare it to learners about which more is known. Specifically, the suggestion is made to compare open learning students with students enrolled in on-campus instruction.

NOTE

#1 The most frequently used taxonomy for levels of learning is Bloom, Englehart, Furst, Hill & Krathwohl (1956). This classification of cognitive learning outcomes is divided into six principle headings. The six classifications are grouped into two divisions: (1) knowledge -- the lowest of the six levels, and (2) comprehension, application, analysis, synthesis, and evaluation -- all of which are characterized as intellectual abilities and skills. As a matter of practicality, Bloom recommends a two-way classification. As this two-way classification is developed as the basis for the present study, a careful distinction must be made. The knowledge classification is defined by Bloom et. al. as:

> ...the recall of specifics and universals, the recall of methods and processes or the recall of a pattern, structure, or setting. For measurement purposes, the recall situation involves little more than bringing to mind the appropriate material ... The knowledge objectives emphasize most the psychological processes of remembering. (p. 202)

The intellectual abilities and skills classification is defined further by Bloom et. al. as:

> ...organized modes of operation and generalized techniques for dealing with materials and problems. The materials and problems may be of such a nature that little or no specialized and technical information is required. Such information as is required can be assumed to be part of the individual's general fund of knowledge. Other problems may require specialized and tech-

> nical information at a rather high level such that specific knowledge and skill in dealing with the problem and the materials is required. The abilities and skills objectives emphasize the mental processes of organizing and re-organizing material to achieve a particular purpose. The materials may be given or remembered. (p. 204)

A number of studies on learning have looked at levels of learning in essentially the same way as the two-way classification defined above. Some of these studies even preceded the Bloom classification. (McKeachie & Kulik, 1975). In their review are listed 31 studies that seem to follow the two-way classification quite closely. They also list an additional 24 studies that generally follow the same classification. In general, the rationale for limiting previous research to two levels of learning involves establishing clear interpretations of the data. Previous researchers have concluded that establishing usable distinctions between the various higher order levels of learning is difficult. This is primarily due to low inter-judge reliability in labeling the various levels. (Seddon, 1978). Even when a high reliability is established by first labeling objectives, the levels were collapsed when judges had to make decisions about practical examples. (Booth, 1973), Thus, based on the review of previous research, the present study accepts the use of a two-way classifications of levels of learning.

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